z/OS

IBM

Planning for Workload License Charges

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Contents

About this document

This document presents information on setting up your system for Workload License Charges (WLC) for IBM products that run under z/OS. This document contains an overview of the components that provide the technology that allows you to effectively enable WLC: the Sub-Capacity Reporting Tool (SCRT), IBM License Manager (ILM), IBM Workload Manager (WLM), and logical partitions (LPARs).

This document is meant to provide a "big picture" of WLC. For implementation details, see the books and Web sites listed under "Where to find more information".

Who should use this document?

This document is intended for administrators who are responsible for configuring IBM products to run on z/OS. These administrators can include:

- System programmers
- System operators
- License administrators

Where to find more information

The following Web site contains more information about Workload License Charges and related topics:

`http://www.ibm.com/zseries/swprice`

The following Web site contains information about announcement letters:

`http://www.ibm.com/zseries/swprice/announce.html`

The following documents contain more information about topics related to Workload License Charges:

@server *zSeries™ Processor Resource/System Manager Planning Guide*

z/OS MVS Planning: Workload Management

S/390® Intelligent Resource Director

z/OS RMF User's Guide

Using the Sub-Capacity Reporting Tool

Hardware Management Console Operations Guide

z/OS HCD User's Guide

Using LookAt to look up message explanations

LookAt is an online facility that allows you to look up explanations for most messages you encounter, as well as for some system abends and codes. Using LookAt to find information is faster than a conventional search because in most cases LookAt goes directly to the message explanation.

You can access LookAt from the Internet at:

`http://www.ibm.com/eserver/zseries/zos/bkserv/lookat/`

or from anywhere in z/OS where you can access a TSO/E command line (for example, TSO/E prompt, ISPF, z/OS UNIX System Services running OMVS). You can also download code from the *z/OS Collection* (SK3T-4269) and the LookAt Web site that will allow you to access LookAt from a handheld computer (Palm Pilot VIIx suggested).

To use LookAt as a TSO/E command, you must have LookAt installed on your host system. You can obtain the LookAt code for TSO/E from a disk on your *z/OS Collection* (SK3T-4269) or from the **News** section on the LookAt Web site.

Some messages have information in more than one document. For those messages, LookAt displays a list of documents in which the message appears.

Accessing z/OS licensed documents on the Internet

z/OS licensed documentation is available on the Internet in PDF format at the IBM Resource Link™ Web site at:

```
http://www.ibm.com/servers/resourcelink
```

Licensed documents are available only to customers with a z/OS license. Access to these documents requires an IBM Resource Link user ID and password, and a key code. With your z/OS order you received a Memo to Licensees, (GI10-0671), that includes this key code. [1]

To obtain your IBM Resource Link user ID and password, log on to:

```
http://www.ibm.com/servers/resourcelink
```

To register for access to the z/OS licensed documents:

1. Sign in to Resource Link using your Resource Link user ID and password.
2. Select **User Profiles** located on the left-hand navigation bar.

Note: You cannot access the z/OS licensed documents unless you have registered for access to them and received an e-mail confirmation informing you that your request has been processed.

Printed licensed documents are not available from IBM.

You can use the PDF format on either **z/OS Licensed Product Library CD-ROM** or IBM Resource Link to print licensed documents.

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1. z/OS.e™ customers received a Memo to Licensees, (GI10-0684) that includes this key code.

Summary of changes

Summary of changes
for SA22-7506-04
z/OS Version 1 Release 4

This document contains information previously presented in SA22-7506-03.

New and changed information

This document includes terminology, maintenance, and editorial changes. For example, an appendix with z/OS product accessibility information has been added.

Technical changes include updates to how Workload License Charges are defined. These technical changes apply to all releases of z/OS.

Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Starting with z/OS V1R2 you may notice changes in the style and structure of some content in this document. The changes are ongoing improvements to the consistency and retrievability of the information in this document.

Chapter 1. Overview

This chapter provides an introduction to Workload License Charges as they relate to z/OS. It explains how the z/OS pricing model differs from that of OS/390®, when z/OS runs on an IBM @server zSeries system running in z/Architecture™ (64-bit) mode. (This book uses the term zSeries to refer to z900 and z800 CPCs. Also, the term z/OS refers to both z/OS and z/OS.e, unless otherwise noted.)

What are Workload License Charges?

Prior to z/OS, IBM software products running on OS/390 were typically priced based on the computing capacity of the central processor complex (CPC) on which the software was running. This pricing method has some limitations, including the following:

- If you are running multiple workloads (using IBM licensed software) on the same CPC, you are charged for those products as though each IBM license is using 100 percent of the CPC all of the time.
- If you purchase more system capacity (hardware) for an existing CPC, your software charges will increase, even if the added capacity is intended for future growth or for new workloads with different software products.

Software has become a large part of most I/S budgets. With the explosive growth of new workloads, particularly in the area of e-business applications, IBM wants to make it more affordable for you to deploy these new workloads — and grow existing workloads — on a zSeries CPC. This is the goal of **Workload License Charges (WLC)**.

With z/OS running on a zSeries CPC you can use a combination of hardware and software to manage your costs and your system capacity with WLC. Under WLC you can be charged – for selected IBM products – for less than the full capacity of the CPC on which the products run.

How are products priced?

Eligible products fall into one of the following two categories of WLC pricing:

- Variable Workload License Charge (VWLC) products -- for these products your charges may be based on less than the full capacity of the CPC on which the products run. VWLC is not available for all products supported by z/OS.

  There are two pricing methods for VWLC products:

  - Full-capacity WLC: For some VWLC products there is a monthly license charge based on the **millions of service units per hour** (MSU) rating of the CPC. You do not have to use the SCRT to enable full-capacity WLC pricing for a CPC.

  - Sub-capacity WLC: For some VWLC products there is a monthly license charge based on less than the MSU rating of the CPC. You must use the SCRT to enable sub-capacity WLC pricing for a CPC.

- Flat Workload License Charge (FWLC) products -- these products have a fixed monthly license charge per product, regardless of the size of the CPC on which the product runs. Once you have a FWLC license for a product, you can run one or more instances of the product on a CPC.

In general, current middleware, for example CICS® and DB2®, qualify for VWLC, and older middleware products and older utilities have FWLC pricing. For more information, see the following Web site:

```
http://www.ibm.com/zseries/swprice/products.html
```

How does WLC work?

When you configure your system such that a VWLC product runs on less than the entire capacity of a CPC, WLC allows you to be billed for the VWLC product accordingly. A CPC's capacity is represented in terms of MSUs. Your cost for a VWLC product is determined by the LPAR utilization capacity associated with the logical partitions (LPARs) in which the VWLC product runs.

What is an LPAR utilization capacity?

The **LPAR utilization capacity** is the highest sum of measured 4-hour rolling MSU averages for the LPARs in which a VWLC product runs concurrently during a given month. Suppose a zSeries CPC has a specific VWLC product running concurrently in three LPARs. The utilization of these three LPARs over a month is used to determine your cost for the product.

For example, the 200-MSU zSeries CPC shown in Figure 1 has three LPARs running concurrently. (In this example, we assume that all of the products are either running 100% of the time, or are running in the hour where the peak utilization occurs.) The LPAR sizes (maximum potential capacities) are the following:

- LPAR 1 is 100 MSUs
- LPAR 2 is 50 MSUs
- LPAR 3 is 50 MSUs

For this example, suppose the LPAR utilization capacity of the following

200 MSUs

LPAR 1 100 MSUs	LPAR 2 50 MSUs	LPAR 3 50 MSUs
z/OS MQ IMS	z/OS MQ CICS DB2	z/OS MQ CICS DB2

Figure 1. LPARs Containing VWLC Products

combinations of LPARs over a given period are:
- LPAR 1: 80 MSUs
- LPAR 2 plus LPAR 3: 70 MSUs
- LPAR 1 plus LPAR 2 plus LPAR 3: 150 MSUs

These LPAR utilization capacities would result in the VWLC products running in these LPARs being priced based on the following capacities.
- z/OS is priced based on 150 MSUs – the LPAR utilization capacity of the LPARs where z/OS runs (LPARs 1, 2, and 3).
- MQ is priced based on 150 MSUs – the LPAR utilization capacity of the LPARs where MQ runs (LPARs 1, 2, and 3).

- IMS™ is priced based on 80 MSUs – the LPAR utilization capacity of the LPAR where IMS runs (LPAR 1).
- CICS is priced based on 70 MSUs – the LPAR utilization capacity of the LPARs where CICS runs (LPARs 2 and 3).
- DB2 is priced based on 70 MSUs – the LPAR utilization capacity of the LPARs where DB2 runs (LPARs 2 and 3).

Note that 4-hour rolling averages are calculated for each hour for each LPAR for a month, the billing period. (This example assumes the VWLC products contained in these LPARs are running for the entire month.) Since LPARs can peak at different times, the LPAR utilization capacity for a combination of LPARs is not necessarily the sum of the individual utilization capacities of those LPARs.

Advantages of WLC

WLC is designed to provide the following advantages:

- Your charges for VWLC products are based on how much the LPARs in which the products run utilize system resources, rather than on the full capacity of the CPC.
- You can benefit from **white space** on a CPC. You can divide a CPC into LPARs that have a total utilization less than the full capacity of the CPC; The portion of hardware that does not carry any software charges is called white space. White space allows you to be charged for less than the full capacity of the CPC. You can use white space to support short term workload spikes and long term workload growth. Once you have white space, you can:
  - Grow an existing workload by increasing the size of an LPAR. Only the products running in this LPAR are affected.
  - Add a new workload by defining a new LPAR.
- You can aggregate MSUs associated with a VWLC product across a parallel sysplex. When you run a VWLC product in multiple LPARs on CPCs which are all part of a parallel sysplex, you pay one base charge for the product.

For more information on pricing terms and conditions for specific products, see the following announcement letters: *IBM Announces Workload License Charges*, *Availability of zSeries Software Charges at Less than Machine Capacity*, and *Changes to Workload License Charges Gives Customers Additional Pricing Options*.

General planning considerations

The following are general hardware and software considerations for enabling sub-capacity WLC:

- You must use an IBM zSeries CPC in z/Architecture (64-bit) mode, and z/OS or z/OS.e must be the only MVS-based operating systems running on the CPC. Note that although z/OS.e itself is not eligible for WLC, products that run under it can be eligible.
- To use WLC on a parallel sysplex, each CPC within the sysplex must meet the above requirements.
- You must define your workload and determine which VWLC products you will run, and you should configure your system into LPARs. For LPAR configuration planning you will need to do the following:
  - Determine the workloads you want to run in each LPAR.
  - Determine the size (system capacity) of each LPAR.

For more information, see "About logical partitions (LPARs)" on page 5 and "Capacity planning" on page 12.

- You should use Workload Manager. Although not required for WLC, Workload Manager in goal mode manages your system based on the workload goals you define. For more information, see "About Workload Manager" on page 6.

Note: Customers are eligible for full capacity WLC pricing once they run the first instance of z/OS on a zSeries box. Sub-capacity requires that all MVS-based operating systems be migrated to z/OS.

IBM's implementation of WLC

IBM is providing a two-stage approach to implementing sub-capacity WLC:
- Currently, you can use the new Sub-Capacity Reporting Tool (SCRT).
- In the future, you can use IBM License Manager (ILM).

The SCRT is an interim solution to implementing WLC at less than full machine capacity until production-level ILM is available. ILM remains a key element of IBM's software license management strategy. For more information on the tool, see "About the sub-capacity reporting tool" on page 5. For more information on ILM, see "About the IBM License Manager" on page 5.

Chapter 2. Components of Workload License Charges

This chapter provides an overview of functions you need to understand to set up your system for WLC, including the Sub-Capacity Reporting Tool, IBM License Manager, logical partitions, and the IBM Workload Manager. It also discusses customer tasks and roles related to these components.

About the sub-capacity reporting tool

The Sub-Capacity Reporting Tool (SCRT) allows you to implement sub-capacity WLC. It assists you in determining, on a zSeries CPC running z/OS or z/OS.e, the LPAR utilization capacity for LPARs in which VWLC products run. The SCRT runs as a stand alone application on a server. It processes SMF records, created by z/OS on the WLC-eligible CPC, and generates a sub-capacity report that you send to IBM. The report is used to determine your charges for VWLC products.

You can download the SCRT from the zSeries software pricing Web page:

`http://www.ibm.com/zseries/swprice/scrt`

Also available on this Web page is the WLC Tool, which reports the rolling 4-hour average for each LPAR. You can use this tool for planning purposes as you prepare to implement sub-capacity WLC.

For more information, see *Using the Sub-Capacity Reporting Tool*, SG24-6522.

About the IBM License Manager

ILM is not available for use at this time. This book describes some ILM function that is expected to be available at a future date. The information is provided for planning purposes only.

ILM, a new function in z/OS, is a combination of license management tools you use to manage software licenses, check compliance with the software license, and manage your inventory of software licenses. That is, ILM keeps track of what products are licensed to which CPCs, and manages the use of these products based on the terms and conditions in the product's license. ILM is based on The Open Group specification for software license use management (XSLM).

About logical partitions (LPARs)

A logical partition (LPAR) refers to a partition on a CPC in which an operating system image (such as z/OS) runs. LPARs allow you to manage your resources by isolating specific workloads for development, test or maintenance work. They also enable you to consolidate your CPCs in an efficient manner. You must define an LPAR when you want an application to run on less than the entire capacity of a CPC.

You define and name LPARs using the Hardware Configuration Definition (HCD). For more information about setting up LPARs for WLC, see "Controlling resources at the LPAR level" on page 9. For general LPAR information, see *z/OS HCD User's Guide*

About Workload Manager

The IBM Workload Manager (WLM) lets you run all of your work concurrently while allocating system resources to the most important work first. WLM generates the 4-hour rolling average that is recorded in SMF records and is used to determine concurrent, hourly LPAR utilization. WLM also manages your defined capacity for an LPAR.

When you run z/OS in goal mode, you define goals for each type of work on your system. WLM uses these goals to determine how much resource (CPU, storage, and I/O) is given to that work to achieve its goal. WLM constantly monitors the system, automatically adjusting the resource allocation as necessary.

For more information, see *z/OS MVS Planning: Workload Management* and *@server zSeries Processor Resource/System Manager Planning Guide*.

Customer tasks and roles

Setting up and managing the components of sub-capacity WLC involves people at your installation who have various roles and responsibilities. For the purposes of this discussion, the job titles Software Asset Manager, System Programmer, and License Administrator are used. What your installation calls these roles and the way your installation chooses to distribute these responsibilities depends on many factors, including the size of your system and the number of products you run.

- Software Asset Manager – in general, a Software Asset Manager may be involved in the following activities:
  - Changing machine model types or serial numbers
  - Ordering a new product or enabling an optional feature
  - Disabling a full product or an optional feature
  - Contacting the procurement or purchasing organization to get approval for a change in billing caused by, for example, increasing the size of an LPAR.
  - Resolving any inconsistencies between the reports generated by the Sub-Capacity Reporting Tool and Transmit System Availbility Data (TSAD) sent to IBM.
  - Reviewing the sub-capacity report to add any required financial data (such as a purchase order number).
- System Programmer – the System Programmer is responsible for system-level z/OS tasks, including:
  - Determining which products will comprise a new workload, and assessing whether additional capacity is needed
  - Installing products
  - Changing the size or number of LPARs
  - Working with the Sub-Capacity Reporting Tool:
    - Collecting SMF data
    - Running the tool against the collected SMF data.
    - Verifying the output.
    - If required, sending TSAD manually to IBM.
    - Calculating the LPAR utilizations associated with VWLC products which do not generate SMF type 89 records.

- Providing LPAR utilizations associated with those products for which there have been special circumstances (such as a disaster recovery situation), and explaining the variance.
        - Editing the sub-capacity report as needed.
        - Sending the report to IBM
    – When the capacity of a VWLC product changes, notifying the Software Asset Manager of the change
    – Moving workloads to a different LPAR
    – Moving a product to a different CPC
    – Monitoring the LPAR capacity being used for each workload, and assessing whether more or less capacity is needed.
- License Administrator – the License Administrator is responsible for all aspects of ILM, including:
    – Installing license certificates
    – Managing license certificates:
        - Deleting certificates
        - Turning priced features in the certificate on or off
        - Downloading replacement certificates
        - Comparing current certificate values with replacement certificate values
    – Listing all products licensed to a machine
    – Performing reconciliation tasks:
        - Creating the reconciliation message
        - Sending the reconciliation message to IBM
        - Receiving the reconciliation receipt from IBM
        - Processing the reconciliation receipt
    – Monitoring existing exceptions and taking action to return to license compliance
    – Recovering from problems associated with IBM License Manager. Recovery activities may also include an operator and a system programmer.
    – Backing up license data bases
    – Managing the repository of original (raw) certificates

Chapter 3. Tuning your system for price performance

This chapter introduces you to the concepts and functions that allow you to optimize your system for WLC.

Controlling resources at the LPAR level

This section discusses ways you can control the size of an LPAR:

- Using a defined capacity
- Defining a hard cap
- Defining no cap
- Using CPU management.

Although you do not need to define an LPAR capping method in order to enable WLC, you may want to consider using a defined capacity – a new function available when you run z/OS on a zSeries CPC – to control your use of an LPAR and thereby control your cost. Other types of LPAR capping methods are discussed in this chapter. The ability to use a hard cap or no cap existed prior to z/OS. You can still use these capping methods when z/OS runs on a zSeries CPC. However, these methods have specific implications for VWLC products. These implications are discussed in this chapter.

Using a defined capacity

A **defined capacity**, also called a "soft cap," refers to the LPAR capacity you define for a workload. A defined capacity allows for spikes in your workload while maintaining an overall 4-hour rolling average. It applies to all the products running in an LPAR, regardless of the number of products the LPAR contains.

Suppose you took your 200 MSU CPC and defined one of the LPARs from the shared pool of LPARs running z/OS and DB2 to have a soft cap of 40 MSUs. That is, your LPAR defined capacity for this LPAR is 40 MSUs. Your DB2 application is allowed to spike above the 40 MSU level as long as its 4-hour rolling average stays under the defined capacity, as shown in Figure 2 on page 10. If the LPAR's 4-hour average rises above its defined capacity value, the Workload Manager limits the LPAR to using no more CPU resource than its defined capacity value.
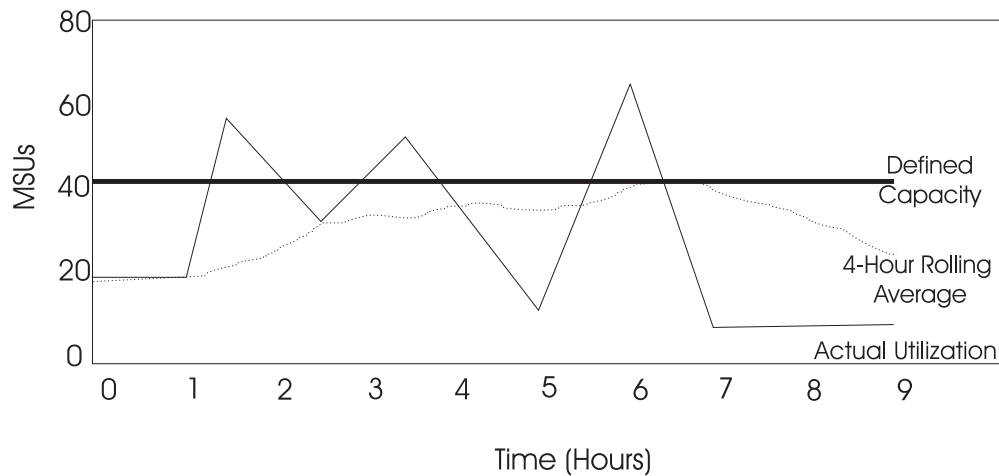
9

Figure 2. How an LPAR Defined Capacity Works

Implications for VWLC

You could at times see a 4-hour rolling average that is greater than the defined capacity. That is, the LPAR utilization capacity may be higher than the defined capacity. When this happens, your cost for the products running in this particular LPAR is based on the defined capacity rather than on the LPAR utilization capacity.

If your goal is to achieve the lowest possible LPAR utilization, you should set a defined capacity that is just high enough to prevent soft-capping from occurring.

With a defined capacity your charges increase only when you increase the defined capacity of the LPAR in which a VWLC product runs, or if you allow the product to run concurrently in additional LPARs.

When capping by the Workload Manager is not in effect, a product running in an LPAR with a defined capacity can spike up to the total capacity available to the LPAR.

Setting up or changing a defined capacity

You define and name an LPAR using HCD. Then you set up a defined capacity by specifying the number of MSUs you want for this partition in the Defined Capacity field on the Hardware Management Console. This field also allows you to dynamically increase or decrease a defined capacity without stopping z/OS or the other product (or products) running in the LPAR.

Note: Once your system is up and running you can use the Change Logical Partition Controls panel to change a defined capacity. To set up a defined capacity at system initialization, you must use the Customize/Delete Activation Profiles selection in the CPC Operational Customization task list.

There are limits to how small an LPAR defined capacity can be and still be managed accurately by the Workload Manager. For more information, see *@server zSeries CPC Processor Resource/System Manager Planning Guide*.

Defining a hard cap

A hard cap, sometimes called a traditional LPAR cap, does not allow any peaks above the cap. You define a hard cap for an application running in an LPAR in

terms of the relative weight associated with the LPAR. Suppose you define three LPARs with the following weights on a 200-MSU CPC:

- LPAR 1 has a relative weight of 500 and has a hard cap
- LPAR 2 has a relative weight of 300 and has a hard cap
- LPAR 3 has a relative weight of 200 and has a hard cap

LPAR 1 receives at most 50% of the system capacity, which on a 200-MSU CPC is 100 MSUs. LPAR 2 receives at most 60 MSUs; LPAR 3 receives at most 40 MSUs.

If you take an LPAR offline, the relative weights of the remaining LPARs are automatically adjusted. For example, suppose you take LPAR 1 offline. The remaining LPARs, LPAR 2 and LPAR 3, have a combined weight of 500. LPAR 2 will then receive at most 300/500 (60%) of the system capacity, which on a 200-MSU CPC is 120 MSUs.

Note that the percentages given here are approximations. Because of the capacity involved in managing LPARs, the total capacity of a CPC that supports multiple LPARs may be less than 100%. For more information, see *@server zSeries 900 Processor Resource/System Manager Planning Guide*.

You define a hard cap for an LPAR on the Change Logical Partition Controls panel by doing the following:

- Select "Initial Capping"
- Do not select "WLM Managed."

Implications for VWLC

When you define a hard cap, your cost for a VWLC product is based on the associated LPAR utilization capacity. Since with a hard cap no workload spiking is allowed, your cost will be less than or equal to the capacity specified in the cap. Note that if the hard cap of an LPAR in which a VWLC product runs is changed as a result of taking another LPAR off line, the LPAR utilization capacity (and thus the cost of the product) could be affected.

Defining an uncapped LPAR

If you define an LPAR without a soft cap or a hard cap, the LPAR receives the overall partition capacity: the individual CPU capacity multiplied by the number of logical CPUs that are online or can be brought online multiplied by the MP (multiprocessor) factor. You define an LPAR to have no cap on the Change Logical Partition Controls panel by doing the following:

- Do not select "Initial Capping"
- Leave the Defined Capacity field blank.

Implications for VWLC

When you define an uncapped LPAR, your cost for a VWLC product is based on the associated LPAR utilization capacity which, depending on the behavior of the workload and on other system activity, could be equal to the capacity of the CPC

Using the Intelligent Resource Director and goal mode with WLC

z/OS includes the Intelligent Resource Director (IRD), which provides support for clusters of LPARs and for CPU management. (For information on other Intelligent Resource Director functions, see *S/390 Intelligent Resource Director*, SG24-5952.) An LPAR cluster refers to the set of z/OS images, running in logical partitions of the same processor, that are part of the same parallel sysplex. LPAR clustering allows you to view partitions as a single pool of computing resources (both processor

resources and I/O resources). When you use logical partitions and Workload Manager goal mode in a WLC environment, you can extend your resource management capabilities across logical partitions by taking advantage of the CPU management performed by the Workload Manager.

There are two aspects to CPU management:

- LPAR weight management -- Workload Manager automatically changes LPAR weights based on your workloads (defined in your WLM goals), allowing you to get the most important work done first. Note that in order to make use of LPAR weight management, your LPAR must not have a hard cap defined.

- LPAR VARY CPU management -- Workload Manager automatically varies online or offline logical CPUs based on your workloads (defined in your WLM goals). This ensures that the number of online logical CPUs is appropriate for the resources being assigned to this LPAR based on its current weight.

Implications for VWLC

Using the IRD, Workload Manager goal mode, and defined capacities ensures that CPU resources perform the most important work first. Because WLM works within the bounds set by the defined capacities, you will need to monitor the capacities and consider changing them when your workloads increase or decrease.

Capacity planning

This section discusses capacity planning for WLC. You should also refer to IBM Washington Systems Center flash 10099, *z/OS Performance: WLM Soft Capping Support for Sub-Capacity Pricing*.

The capacity planning lifecycle, as it relates to WLC, consists of the following tasks:

1. Measuring your use of system resources
2. Configuring LPARs
3. Optimizing your resources

Measuring your use of system resources

The first step of capacity planning is to measure the system resources being consumed by your existing software programs. The following tools are available to help you do this:

- CP2000 capacity planning tool – this tool can be used by your IBM representative to display the rolling 4-hour MSU average for each LPAR.

- WLC Tool – available to IBM customers, this tool also reports the rolling 4-hour MSU average for each LPAR. You can download this tool from the following Web site:

  http://www.ibm.com/zseries/swprice

- RMF™ Partition Data report – the Resource Measurement Facility (RMF) allows you to run reports that tell you how much system capacity your LPARs are actually using. You can use the RMF Partition Data Report to determine:

  – The capacity of an LPAR in MSUs

  – The CPU usage of an LPAR in MSUs

  – The percentage of time an LPAR was capped to enforce a soft cap. Figure 3 on page 13 shows sample output from the RMF Partition Data Report. The CAPPING WLM% field indicates whether WLM is applying a soft cap to an LPAR. For example, the LPAR NP4 is being limited in it's ability to use CPU resource, because of a soft cap, 86.7% of the time.

Figure 3. Sample RMF Output with a Defined Capacity

```
        --------- PARTITION DATA --------------   --LOGICAL PARTITION PROCESSOR DATA--

                   ----MSU----  -CAPPING--  PROCESSOR-  ----DISPATCH TIME DATA----
        NAME  S  WGT  DEF    ACT  DEF   WLM%  NUM   TYPE   EFFECTIVE        TOTAL

        NP1   A  400    0      5  NO    0.0    4    CP   00.02.27.649  00.02.30.388
        NP2   A  200    0      5  NO    0.0    4    CP   00.02.28.330  00.02.30.449
        NP3   A  200    0     65  NO    0.0    4    CP   00.31.47.073  00.31.47.881
        NP4   A  400   50     54  NO   86.7    4    CP   00.26.46.161  00.26.45.617
        NP5   A  850   50      5  NO    0.0    5    CP   00.02.14.117  00.02.16.743
        CB88  A   10    0      0  NO    0.0    2    CP   00.00.00.000  00.00.00.000
        CFC1  A  DED    0     30        0.0    1    CP   00.14.59.839  00.14.59.862
        CFC2  A  DED    0     30        0.0    1    CP   00.14.59.945  00.14.59.963
        *PHYSICAL*                                                     00.00.50.252

                                                         ------------  ------------
        TOTAL                                            01.35.43.117  01.36.41.158
```

For more information, see *z/OS RMF User's Guide.*

z/VM™ considerations

When VWLC products run in a z/OS guest running under z/VM, these products are priced based on the maximum potential size of the LPAR in which they run. This is because the technology required for determining LPAR utilization capacity is not available to z/VM. The size of an LPAR in which z/VM runs is equal to the number of processors assigned times the MSUs per processor of the CPC. Regardless of configuration, software charges cannot be based on MSUs beyond machine capacity.

Figure 4 shows a zSeries machine with 4 engines, rated at 200 MSUs. It is configured with four LPARs, as follows:
- LPAR 1 has two logical CPs and runs z/OS natively, CICS, and DB2.
- LPAR 2 has one logical CP and runs z/VM with one z/OS guest.
- LPAR 3 has one logical CP and runs z/VM with two z/OS guests and one Linux guest.
- LPAR 4 has two logical CPs and runs Linux.

200 MSUs

LPAR 1 50 MSUs	LPAR 2 50 MSUs	LPAR 3 50 MSUs	LPAR 4 50 MSUs
z/OS CICS DB2	z/VM	z/VM	LINUX
	z/OS	z/OS LINUX	

Figure 4. zSeries sub-capacity pricing and z/VM

Note the following regarding the LPAR sizes shown in Figure 4:
- The size of LPAR 1 is the maximum LPAR utilization of the LPAR.

- The sizes of LPAR 2 and LPAR 3 are each 50 MSUs, based on the maximum potential capacity of each LPAR. Maximum potential capacity may be determined by examining the number of logical CPs assigned to each VM LPAR, and the capacity of each CP. This machine is rated 200 MSUs and has 4 physical CPs, meaning that each engine is approximately 50 MSUs (200 MSUs / 4 engines). LPARs 2 and 3 each have one logical CP meaning that each LPAR carries a WLC-capacity of 50 MSUs.

These LPAR sizes would result in the products running in these LPARs being priced based on the following capacities:

- z/OS is priced based on 150 MSUs – the total MSUs of the LPARs where z/OS runs (LPARs 1, 2, and 3).
- CICS is priced based on 50 MSUs – the MSUs used by the LPAR where CICS runs (LPARs 1).
- DB2 is priced based on 50 MSUs – the MSUs used by the LPAR where DB2 runs (LPAR 1).
- z/VM Version 3 has flat pricing, since it is an FWLC product. z/VM Version 4 is engine based one-time-charge with trailing support and subscription.
- LINUX is not eligible for sub-capacity pricing.

Additional considerations

The following are additional LPAR configuration recommendations:

- Make sure FWLC products run on appropriate CPCs in your configuration. For these types of products you are charged for each CPC running the application.
- If with your zSeries CPC you order the Integrated Facility for Linux (IFL), the capacity of an IFL is "invisible" to z/OS in that it is not considered to be part of the full CPC capacity. This means that WLC does not apply to any Linux LPARs running in an IFL. (Similarly, you can order Integrated Coupling Facilities to run coupling facility LPARs. These LPARs are also invisible to z/OS.)

  If however you set up a non-IFL LPAR containing Linux, the Linux LPAR capacity is included in the total CPC capacity.

Optimizing your resources

To optimize your system, you should attempt to maintain a balance between system performance and WLC pricing benefits. Once you have a product running in an LPAR:

- If the LPAR has a defined capacity you should consider gradually lower the LPAR size until the Workload Manager begins capping the LPAR. Examine the LPAR RMF report that shows the percentage of time the LPAR was capped. If necessary, raise the capacity of the LPAR so that the LPAR is capped only 1 to 5 percent of the time. This ensures you are getting your work done optimally at the lowest cost.
- You should consider tuning your system capacity from time to time based on RMF reports:
  - If an RMF report shows, for example, that an LPAR is consistently running at 95% of capacity (MSUs), you should consider increasing the size of the LPAR.
  - If an RMF report shows, for example, that an LPAR is consistently running at 40% of capacity (MSUs), you should consider decreasing the size of the LPAR.

Appendix. Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features in z/OS enable users to:

- Use assistive technologies such as screen-readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

Using assistive technologies

Assistive technology products, such as screen-readers, function with the user interfaces found in z/OS. Consult the assistive technology documentation for specific information when using it to access z/OS interfaces.

Keyboard navigation of the user interface

Users can access z/OS user interfaces using TSO/E or ISPF. Refer to *z/OS TSO/E Primer*, *z/OS TSO/E User's Guide*, and *z/OS ISPF User's Guide Volume I* for information about accessing TSO/E and ISPF interfaces. These guides describe how to use TSO/E and ISPF, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

Additional accessibility features may be included as part of the user interface of a particular z/OS element. Check the individual element's documentation for any additional information about accessibility.

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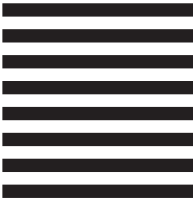
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